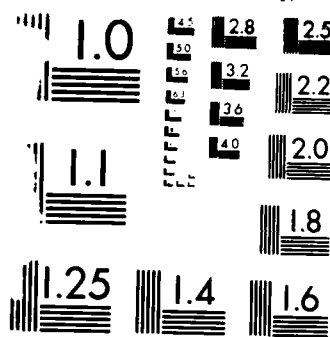MICROCOPY RESOLUTION TEST CHART

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FINAL REPORT
FOR CONTRACT N00014-84-C-0136

LFA DATA ANALYSIS AND EXTENDED MODELING

SAIC-86/1586

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Report SAIC-86/1586

FINAL REPORT FOR CONTRACT N00014-84-C-0136
LFA DATA ANALYSIS AND EXTENDED MODELING

Prepared by

C.W. Spofford
X.A. Zabal

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20 March 1986

Final Report

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Data analysis and modeling for sea surface and bottom reverberation is summarized in the formal and final report for ONR contract number N00014-84-C-0136.
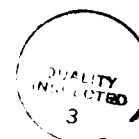
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FINAL REPORT FOR CONTRACT N00014-84-C-0136
LFA DATA ANALYSIS AND EXTENDED MODELING

1.   INTRODUCTION

   1.1 <u>Contract Information.</u>   This document is the final report for
Office of Naval Research Contract Number N00014-84-C-0136, Tasks I and II.
The work under this contract was conducted by Science Applications
International Corporation (SAIC) during the period from 19 January 1984
through 20 January 1986.

   1.2 <u>Reports.</u>   The bulk of the work under this contract has been
reported to the COTR during the Performance Assessment ("GLUE") Group
meetings.   Other efforts pertinent to this contract have been documented
in SAIC Report Nos. DCN-842189, DCN-842628, DCN-843997, DCN-850411,
DCN-852193 and DCN-853957.

2.   TASK I - DATA ANALYSIS AND INTERPRETATION

   2.1 <u>Statement of Work.</u>   "SAIC will process, analyze and interpret
data from several Navy experiments to characterize the reverberation
environment for low-frequency active systems.   Efforts will include evalu-
ation and modification of state-of-the-art LFA models, and specification
of critical measurements for follow-on exercises."

   2.2 <u>Bistatic Surface Scattering Strengths.</u>   SAIC processed data
collected during the AAUS and LFA exercises to measure and quantify sur-
face scattering strengths in a bistatic geometry and determine the spectra
of the backscattered field.

   2.3 <u>Monostatic Sea Surface and Bottom Backscattering.</u>   SAIC pro-
cessed and analyzed data collected during the AAUS and LFA exercises to
determine and evaluate the scattering strengths of the sea surface at the
convergence zones and spectra of the acoustic field scattered from the sea
surface and ocean bottom.   This analysis included the modeling of he
effects of source/receiver characteristics, data recording system, and
platform dynamics during the data collection.

   2.4 <u>Scattering Models.</u>   The measured scattering strength levels were
compared to the predictions of models developed at SAIC and described in
the following paragraphs.

   2.4.1 Bistatic Scattering Strength Model.   In order to interpret and
evaluate the measured data in the bistatic configuration, W.D. Kirby of
SAIC upgraded the Generic Sonar Model to predict bistatic reverberation.

   2.4.2 Surface Backscattering Model.   A composite roughness model of
surface backscatter was developed; the cut-off wave number for sea surface
spectrum partition was determined based on physical considerations.   A

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good agreement between the model predictions of scattering strength and the measured data was reported.

2.4.3 Bottom Backscattering Model. The experimental data were compared to predictions of a model of bottom backscatter with Lambert's law and parameters derived from the Bottom Loss Upgrade (BLUG) database. Good agreement with the data was reported.

3. TASK II - EXTENDED MODELING

3.1 Statement of Work. "SAIC will extend the present modeling capability to incorporate selective spectral spreads for bottom reverberation and surface-duct environments to achieve a complete system-performance estimation capability."

3.2 Multiple Bounce Forward Scattering Model. SAIC personnel (C.W. Spofford and A.P. Stokes) developed a model to predict the spectrum of multiple-bounce forward scattered signal; the model considers linear as well as non-linear surface wave interaction. This model has a direct application to surface-duct environments.

3.3 Surface Reverberation Modeling. C.W. Spofford directed the activities of a surface reverberation modeling group. The effort concentrated on developing models and evaluating theories of surface backscatter with the objective of gaining understanding on some characteristics exhibited by the experimental data. During this effort models based on Kirchhoff, perturbation, and composite roughness theories were developed and evaluated, and the effects of signal waveform on scattering strength measurements were investigated.

4. OTHER EFFORTS

4.1 Activities. During the contract period SAIC participated in several efforts in support of the LFA program:

4.1.1 Channel Characterization. C.W. Spofford had full responsibility for acoustic channel characterization in the GLUE group. He was responsible for providing estimates of system performance degradation due to channel characteristics, proposing processing methods to minimize the losses, identifying environmental issues that had to be resolved and specifying the required experimental measurements.

4.1.2 Experiment Planning. SAIC actively participated in the planning of LFA Fixed-Fixed experiment. This involvement included the predictions for system performance and overall design to assure the collection of meaningful data with the assets available for the exercise.

4.1.3 Shallow Water LFA Concepts. SAIC took full responsibility for the design of the shallow-water phase of the Fixed-Fixed experiment. This effort included the formulation of an active barrier concept and a measurement plan for concept validation.

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